

Managing the open abdomen in a district general hospital

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ABSTRACT

INTRODUCTION The need to manage an open abdomen is becoming more common in general surgical practice and a variety of methods of temporary abdominal closure (TAC) are available. The evidence for the efficacy of the various forms of TAC as well as the subsequent definitive fascial closure (DFC) rates and complications comes mainly from large trauma series in the US, which represent a different patient population to those in the UK in whom TAC is usually required.

METHODS All cases of open abdomen management in our hospital over a five-year period were reviewed to ascertain the methods of TAC used, our success in achieving DFC and the applicability of managing such cases in a district hospital environment.

RESULTS Nineteen patients underwent TAC, with two deaths (10.5%) and an overall DFC rate at hospital discharge of 12/17 (70.6%). The median lengths of critical care and hospital stays were 19.5 and 38.0 days respectively. Thirteen out of seventeen survivors had at least one significant complication.

CONCLUSIONS The management of the open abdomen can be achieved safely in a district general hospital setting with acceptable outcomes for the non-trauma patients commonly seen in UK practice but it is a resource intensive and expensive undertaking.

KEYWORDS

Ventral hernia – Surgical mesh – Negative pressure wound therapy

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Ogilvie first described a method of temporary abdominal closure (TAC) during the Second World War¹ but it has come to prominence with the wider recognition of the harmful effects of abdominal compartment syndrome (ACS)² and the role of damage control surgery.³ The management of the open abdomen necessitates some form of TAC, which may change over time, and may include a plan to progress to definitive abdominal fascial closure or default to a planned ventral hernia (Table 1).

Patients with open abdomens that do not achieve definitive fascial closure (DFC) by the time of hospital discharge have prolonged worsened physical and mental wellbeing⁴ and are responsible for significant societal and healthcare costs.⁵ The Open Abdomen Advisory Panel therefore recommends: ‘... all appropriate efforts to attempt definitive closure of the abdominal defect within the initial hospitalization’.⁶ The evidence for open abdomen management (OAM) is derived largely from post-trauma laparotomies, predominantly from the US.⁷ The literature on OAM following septic catastrophe, the situation usually encountered in European countries, is more scarce^{8–12} and reports from the UK total fewer than 150 patients.^{13–18} Only two of these reports are not from university teaching hospitals. We present the outcomes of a

consecutive series of patients who underwent OAM in a UK district general hospital (DGH) serving a population of approximately 275,000 people.

Methods

In the absence of specific clinical codes for OAM, after registration with the hospital’s clinical effectiveness department, the theatre logs for January 2007 to December 2011 were searched to find all potential cases. Operations described as ‘relook laparotomy’, ‘abdominal washout’, ‘resuture of abdomen’, ‘burst abdomen’ and ‘temporary abdominal closure’ or variations thereof were identified, as were any operations where it was recorded that gauze had been retained in the patient. The notes of all such patients were retrieved to exclude those who did not undergo OAM. The remaining cases were analysed to provide demographic, surgical and outcome data.

Results

For the 60-month study period, 65 potential open abdomen cases were identified. Of these, 46 cases were not relevant to our study, leaving 19 cases for review (Fig 1). There

Table 1 Definition of terms related to open abdomen management (adapted from Zarzaur *et al*)⁴

Term	Definition
Open abdomen	Any abdomen in which definitive fascial closure cannot be achieved
Temporary abdominal closure	Any method used to control the egress of abdominal contents without closure of the abdominal wall fascia
Definitive (primary) fascial closure	Fascia-to-fascia closure of abdominal defect with or without prosthetic repair material within the initial hospitalisation
Planned ventral hernia	An open abdominal wound that is allowed to granulate and covered with a skin graft before patient discharge with the intention to perform definitive repair in 6–12 months or an abdomen in which deliberate skin-only closure is performed

were 11 male patients and the median age was 62.5 years (range: 19–75 years). Ten open abdomens followed complications of elective surgery, eight cases followed complications of emergency surgery and one was managed as an open abdomen from the initial operation (Table 2).

Intra-abdominal sepsis was the reason for TAC in 17/19 cases, planned relook laparotomy in 10/19 cases and worry over ACS in 3/19 cases. The decision in each case was made by a consultant surgeon either in attendance or after telephone discussion. OpSite® (Smith and Nephew, London, UK) sheet coverage was the most common method of initial TAC, followed by use of a cut open sterile saline bag sutured to the fascia or skin (Bogota bag). Although there was no increase in the frequency of OAM over the study period, mesh mediated fascial traction (MMFT) was used more frequently as surgeons with a specific interest in managing the abdominal wall became increasingly involved in all of the unit's open abdomen cases.

All 19 patients required admission to the intensive care unit (ICU), (median: 8.5 days, range: 1–51 days). Two patients died from overwhelming sepsis on days 1 and 10 of their ICU stays. Of the 17 survivors, 14 also required high dependency unit care for a median 6.5 days (range: 1–22 days).

Thirteen of the survivors had complications. Pneumonia ($n=5$) and multiorgan dysfunction ($n=5$) were the most common, with others including single cases of myocardial infarction, pulmonary embolism, acute kidney injury and small bowel fistulation. Sixteen patients had nasogastric/jejunal feeding and one patient had distal limb feeding through his stoma. Twelve patients required total parenteral nutrition. A median number of two (range: 0–10) further operations were needed following the institution of TAC and twelve patients had DFC at discharge, equating to 63% of all OAM patients or 71% of survivors (12/17). Fascial closure was achieved using continuous size 1 nylon or polydioxanone sutures, supported on occasion by full-thickness deep tension sutures. There were no significant differences in demographic, disease or operative characteristics between those who achieved DFC and those who did not. The average length of hospital stay for survivors was 54 days (range: 16–154 days).

Of the seven patients who did not achieve DFC, two died, three were discharged with ventral hernias and were later reconstructed (one in our hospital and two in a tertiary referral plastic surgery unit), one patient was transferred to a tertiary referral centre during the acute episode and the final patient is awaiting maturation of his laparostomy before reconstruction of a planned ventral hernia. Five out of eight survivors treated with negative pressure wound therapy (NPWT) achieved DFC, with one enterocutaneous fistula. Four out of four treated with MMFT achieved DFC although one dehiscence while in hospital and was discharged with a ventral hernia. Four out of four patients treated with Bogota bag closure were closed at the first or second laparotomy after institution of TAC. The four patients who achieved fascial closure after the Bogota bag TAC had fewer returns to theatre (mean: 1.75) than the nine patients who were closed after NPWT or MMFT (mean 3.655) although this did not reach statistical significance ($p=0.14$, Student's *t*-test for independent means).

Discussion

OAM has been credited with improving outcomes after trauma, and its acceptance has been linked with the growing realisation of the role of damage control surgery and the consequences of ACS.¹⁹ The literature is predominantly

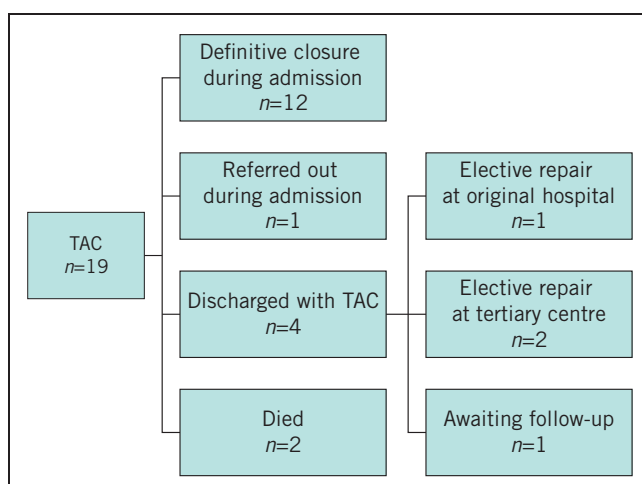


Figure 1 Outcome of 19 open abdomen cases. TAC = temporary abdominal closure.

Table 2 Demographics and surgical details of 19 open abdomen cases

Features	DFC achieved (n=12)	DFC not achieved (n=7)
Median age (range)	62.5 (19–75)	63.0 (36–69)
<i>Co-morbidities</i>		
Ischaemic heart disease	4 (33%)	3 (43%)
Malignancy	6 (50%)	1 (14%)
Hypertension	2 (17%)	1 (14%)
Hypothyroidism	1 (8%)	2 (29%)
Stroke	1 (8%)	1 (14%)
<i>Indication for TAC</i>		
Intra-abdominal sepsis	12 (100%)	5 (71%)
Planned relook	5 (42%)	5 (71%)
Concerns over ACS	3 (25%)	0 (0%)
<i>Index TAC technique</i>		
Bogota bag	6 (50%)	1 (14%)
OpSite® sheet/sandwich	4 (33%)	5 (71%)
NPWT	0 (0%)	0 (0%)
MMFT	1 (8%)	1 (14%)
Loose gauze packing	1 (8%)	0 (0%)
<i>Secondary TAC technique</i>		
Bogota bag	4 (33%)	0 (0%)
OpSite® sheet/sandwich	0 (0%)	3 (43%)
NPWT	5 (42%)	3 (43%)
MMFT	3 (25%)	1 (14%)
<i>Complications</i>		
Death	0 (0%)	2 (29%)
Pneumonia	3 (25%)	2 (29%)
Multiorgan dysfunction	1 (8%)	2 (29%)
Small bowel fistula	0 (0%)	1 (14%)
DFC = definitive fascial closure; TAC = temporary abdominal closure; ACS = abdominal compartment syndrome; NPWT = negative pressure wound therapy; MMFT = mesh mediated fascial traction.		

derived from major US trauma centres or tertiary referral centres in Europe and the evidence of UK practice is sparse. Guidelines for OAM reflect US practice and offer no guidance as to what facilities should be available in a UK hospital managing the open abdomen.^{4,20}

Two key features of OAM will facilitate DFC: the prevention of visceral adhesions to the underside of the anterior abdominal wall and maintenance of domain as the forces on the divided wall pull the fascial edges laterally.^{4,17} Much of the debate regarding TAC centres on which technique achieves these aims in the most reliable and complication free manner.

Temporary abdominal closure techniques

Measures such as the Bogota bag prevent evisceration and increase the abdominal domain by a silo effect but do not facilitate fascial reapproximation. Placement of a Bogota bag at the first operation at which the abdomen is left open is common but in cases where no other TAC is used, DFC rates are low.²¹ The OpSite® sandwich is another simple technique and has a DFC rate of 91%.¹⁵

The most common method employed currently applies negative pressure therapy to the abdominal wound either by homemade systems with various modifications²² or commercially available kits. Application of negative pressure manages the exudate from the abdomen and maintains inward traction on the fascia while the use of a plastic sheet prevents visceral adhesions, allowing direct fascial suture in due course. DFC rates of 100% have been reported.²³ Acceptance of abdominal NPWT is hindered by worries over enterocutaneous fistulation rates of up to 15%²⁴ although it is considered safe by the Open Abdomen Advisory Panel.⁴ Enterocutaneous fistulation in an open abdomen rarely closes spontaneously, and increases mortality and morbidity.²⁵ The UK's National Institute of Health and Care Excellence commented in 2009 that evidence supporting NPWT was 'inadequate in both quantity and quality',²⁶ and the results of an 18-month countrywide prospective audit were published in 2013.²⁷

The Wittmann Patch® (Starsurgical, Burlington, WI, US) is a patented hook and burr device that is sutured to the abdominal wall fascia, providing inward traction to regain and maintain the abdominal domain.²⁸ The fascia is closed once apposition is adequately regained. The technique has been modified by the insertion of a fenestrated sheet inside the abdominal cavity and a vacuum pack above the patch to control fluid egress.²⁹ The rate of DFC varies between studies from 82% to 95%, with a low rate of complications.^{28,30}

The final commonly employed method of TAC is MMFT, where a fenestrated plastic sheet is placed under a non-absorbable mesh sutured to the edges of the fascial defect. The mesh is tightened sequentially in the midline by reefing with towel clips or suture. If access to the abdominal cavity is required, the mesh is divided, trimmed and sutured back in the midline; inward traction of the mesh continues until the fascial edges are reapproximated and then closed. It, too, can be modified by the use of topical negative pressure to control fluid egress. Outcomes are good with DFC rates of 77–100%^{31,32} and minimal rates of fistulation.

Although doubtless significant, the overall financial impact of OAM is poorly quantified. However, in one study, hospital charges for those managed with NPWT totalled approximately \$25,000 per patient.³³

Reviews of the literature focus on the rates of DFC as well as complications such as mortality and enterocutaneous fistulation as major endpoints.^{7,19,34} The aim of our study was to assess whether the outcomes from our DGH were comparable with those published. These patients are extremely resource intensive with prolonged critical care and overall hospital stays, requirements for multiple trips

Table 3 UK series of open abdomen management

Authors	Study period	n	Indication	Method	Mortality	DFC	EFC	Comments
Subramonia ¹³	2006–2007	19*	Abdominal sepsis (10), dehiscence (9)	VAC	7/51 (14%)	31/51 (61%)	2/51 (4%)	Specific data for the 19 open abdomens not reported
Amin ¹⁴	2005–2008	20	Abdominal sepsis	VAC	0/20 (0%)	15/20 (75%)	2/20 (10%)	
Horwood ¹⁵	2003–2008	27	Abdominal sepsis	VAC	10/27 (35%)	5/17 (29%)	2/17 (11%)	
Wilde ¹⁶	36 months	11	Abdominal sepsis (8), ischaemia (2), haemorrhage (1)	OpSite® sandwich	0/11 (0%)	10/11 (91%)	2/11 (18%)	
Rao ¹⁷	2003–2005	29	Peritonitis (20), oedema (5); ACS (4)	VAC	10/29 (34%)	0/29 (0%)	6/29 (21%)	DFC not attempted
Anderson ¹⁸	2003–2009	29	Abdominal sepsis	VAC	9/29 (31%)	0/29 (0%)	9/29 (31%)	DFC not attempted. Later reconstruction in 14/18 patients.

VAC = vacuum assisted closure; ACS = abdominal compartment syndrome; DFC = delayed fascial closure (number of fascial closures achieved on index hospital admission in survivors); EFC = enterocutaneous fistula.
*51 patients reported of which 32 had partial-thickness abdominal wound dehiscence rather than an open abdomen.

to theatre and ongoing nutritional support. Our hospital and ICU length of stay, complication rates and mortality rates are comparable with other reported data, and we only suffered one enterocutaneous fistula in a patient in whom multiple enterotomies were exteriorised. Our DFC rate of 71% compares favourably with the 22–88% closure rates from other series of open abdomens for abdominal sepsis,^{8–10,12,14,21} particularly as it was an unselected group of patients treated by different surgeons using a variety of techniques.

Studies have shown that a defined algorithm for OAM using NPWT⁵⁵ or the Wittmann Patch^{®56} improves the rate of DFC. Broadly, the published protocols involve repeated trips to theatre every 2–5 days where approximation is attempted sequentially until DFC or until dressing changes interfere with patient recovery. A similar protocol has been introduced in our hospital based around MMFT.

This study is limited by its retrospective nature and relatively small, heterogeneous cohort of patients but it does highlight the lack of consistency of practice of OAM and adds to the literature on OAM in the UK (Table 3). Two Canadian studies have also demonstrated a wide variation in practice in OAM,^{57,58} and a survey of Norwegian surgical units revealed that only 39% of surgeons would attempt DFC after TAC and would refer patients to a tertiary centre.⁵⁹

It is likely that no matter which TAC is used, a proportion of these patients will be discharged without DFC and it is important to realise that discharge from hospital is not the end of the patients' healthcare requirements; they should, if at all possible, be offered abdominal wall reconstruction. That, in itself, is a considerable undertaking and requires a surgeon experienced in a variety of reconstructive techniques including component separation.⁸

Conclusions

The role of OAM is increasingly well established in trauma, ACS and the catastrophically septic abdomen. DFC has both individual and healthcare system benefits, and is the ultimate aim of such management. A variety of techniques for TAC exist and the success rates of achieving DFC vary widely; OAM for intra-abdominal infection results in a lower rate of DFC than in trauma, regardless of which technique is used. This report demonstrates that open abdomens can be managed safely outside of tertiary referral centres, and acceptable fascial closure and complication rates can be achieved. However, managing these patients is resource intensive and expensive, and is best undertaken by an interested surgeon.

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